User's Manual

COBHAM

The most important thing we build is trust.

Messenger Digital Transmitter (MDT-B)

- Broadcast Version -

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1.0 Important Warning and General Safety Information

The following information is presented to the operator to ensure awareness of **potential harmful RF (**radio frequency**) exposure** and general hazards. With regards to potential harmful RF electromagnetic fields the text below is only a brief summary highlighting the possible risks and how to minimize exposure. The summary is based on OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" [1]. The user should carefully read and comprehend the following before operating the equipment and for additional in depth information refer to OET Bulletin 65.

1. FCC has set guidelines [1] for evaluating exposure to RF emissions that the user must be aware of when operating GMS's MDT-B microwave transmitter. The maximum power density allowed at 1500 – 100,000 MHz is **5mW/cm^2** for occupational/controlled exposure* and **1mW/cm^2** for general population/uncontrolled exposure**. These are the limits for maximum permissible exposure (MPE) as called out in the FCC guidelines (for the above mentioned frequencies).

2. Exposure is based on upon the average time spent within the RF field with a given intensity (field units in mW/cm^2). Hence it may be controlled (or at least minimized) by observing the safe distances and time exposed as shown in Table 1. These safe distances are calculated from equations predicting RF Fields [3] with the following assumptions:

    - The transmitter maximum power is 23dBm (0.2W)
    - The antenna used has a 2dBi gain
    - The transmitter is used in a fixed location

* "*Occupational /controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. ....." [2]*

***** "*General population/uncontrolled exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment-related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area." [2]*

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[1] OET Bulletin 65, Appendix A Table 1 Limits for MPE
http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf
[2] OET Bulletin 65, page 9, definitions of types of exposure
http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf
[3] OET Bulletin 65, page 19, Equations for predicting RF Fields
http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf
The user (and bystanders) should remain beyond the distances from the antenna at all times as stated in Table 1 when the transmitter is operating for no longer than the time periods indicated (keeping in mind this is the average time).

If any of the above variables change, such as a higher gain antenna, less or more power output from the transmitter, additional transmitters used, etc. then the safe distances would need to be recalculated. The user can either refer to the equations predicting RF Fields as noted in the above section or call contact GMS for advice at (760)-496-0055.

Table 1 – Safe Distances

Frequency = 1500 - 100,000 MHZ	MDTB Transmitter Power = 0.2W (+23 dBm)		Antenna Gain = +2dbi
Occupational /controlled exposure (5mW/cm^2)		*General population/uncontrolled exposure (1mW/cm^2)*	
Safe Distance	Average Time	Safe Distance	Average Time
2.2 cm	**6 minutes**	**5 cm**	**30 minutes**

3. The transmitter, which can be operated in fixed or mobile applications, is rated at 0.2W (+23dBm) RF power and is capable of harmful radiation if safe operating practices are not observed (see sections 1 & 2 above).

4. It should be noted that this device is an intentional radiator and that any changes or modifications not expressly approved could void the user's authority to operate the equipment.

5. Do not substitute any antenna for the one supplied or recommended by the manufacturer. The installer is responsible for ensuring that the proper antenna is installed.

6. Antenna minimum safe operating distances should be observed as stated in section 2 above. It is the responsibility of the qualified end-user of this intentional radiator to control the safe distances and exposure limits to bystanders.

7. DC power (+12VDC) to the unit should never be applied until the antenna (or other suitable load) has been attached to the device SMA RF output connector. Safe operating procedures must be observed when unit is transmitting into an antenna (see sections 1 & 2 above).

8. Electro-Static Discharge (ESD) precautions should be observed as a safe practice.

9. The transmitter will generate considerable heat and is the responsibility of the end user to properly heat sink the device before using.

2.0 Acronyms

This section lists and describes the various acronyms used in this document.

Name	Meaning
16 QAM	16-state Quadrature Amplitude Modulation
64 QAM	64-state Quadrature Amplitude Modulation
A/V	Audio/Video
AES	Advanced Encryption System (32 bit)
ABS	Messenger Basic Scrambling (8 bit)
ASI	Asynchronous Serial Interface
COFDM	Coded Orthogonal Frequency Division Multiplexing
CVBS/Y	Composite video/Luminance with S-video
C	Chroma video
D/C	Down-Converter
FEC	Forward Error Correction
GUI	Graphical User Interface
I/O	Input/ Output
Kbaud	Kilobaud per second
Kbps	Kilobits per second
Mbps	Megabits per second
MDL	Messenger Digital Link
MDL-B	Messenger Digital Link, Broadcast Version
MDR	Messenger Digital Receiver
MDR-B	Messenger Digital Receiver, Broadcast Version
MDT	Messenger Digital Transmitter
MDT-B	Messenger Digital Transmitter, Broadcast Version
MER	Modulation Error Rate
MPEG	Moving Picture Experts Group
NTSC	National Television System Committee
PAL	Phase Alternation Line
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RX	Receiver
S/N	Signal-to-Noise Ratio
THD	Total Harmonic Distortion
SDI	Serial Digital Interface
TX	Transmitter
VDC	Volts (Direct Current)

3.0 Introduction

The Broadcast version of the Messenger Digital Link (MDL) includes the Broadcast version of both the Messenger Digital Transmitter (MDT-B), the Messenger Digital Receiver (MDR-B), and one or two external Down Converters (sold separately) for frequencies exceeding the direct input of 861 MHz. The MDT-B (Messenger Digital Transmitter, Broadcast version) also works with any DVB-T compliant receiver.

The Broadcast version of the MDL (Messenger Digital Link) provides professional Audio/Video (A/V) interfaces and processing. All versions of the MDL use a robust digital modulation system known as Coded Orthogonal Frequency Division Multiplexed (COFDM) that provides frequency diversity and powerful Forward Error Correction (FEC) algorithms. The MDL provides a robust wireless link that is effective against the multipath interference experienced by analog systems, and provides crisp, clear pictures in the most difficult of terrains.

This manual provides information on how to operate the MDT-B as well as pertinent technical information related to the overall system. Also refer to model identifier (on-line document, 100-MNI0031) at GMS website, www.gmsinc.com, for available frequency and power configurations along with available options.

3.1 Key System Features

- SDI, ASI, Component, S-Video & Composite Interfaces
- 4:2:2 and 4:2:0
- Coded Orthogonal Frequency Division Multiplexed (COFDM) Modulation
- Output Frequency 1 to 6 GHz (In-Bands)
- Low System latency (~80ms)
- Built-in MPEG-2 Encoder
- Companion COFDM Receiver with Maximal Ratio Pre-Detect Diversity Reception.
- Rugged and Compact Portable Design

4.0 Theory of Operation

The MDT-B Broadcast version accepts either an ASI (Asynchronous Serial Interface,) SDI (Serial Digital Interface), Component, S-Video or Composite video signal and embedded audio or analog stereo audio inputs (mic or line level). The video is compressed (ASI data streams are passed through bypassing the MPEG encoder) according to MPEG-2 specifications. The MPEG-2 supports 4:2:2 or 4:2:0 chroma sampling, 422P@ML, MP@ML and SP@ML profiles and maintains the original signal's video fidelity. The audio is compressed using MPEG Layer II compression. The audio, video and data packet PES streams are multiplexed with basic service data to indicate the service name and transmitted across the wireless link.

Additionally, the MDT-B/MDR-B combination employs a specially designed 'low delay' coding technology, which provides an end-to-end latency of approximately 80ms without the introduction of any further MPEG encoding artifacts. This ensures that the picture you see is what is happening *now* – crucial for applications such as sports coverage.

5.0 Getting Started

The standard MDT kit includes the following items:

- MDT-B unit (example GMS p/n MDTF1A0NXXX001)
- MDT-B full breakout cable (GMS p/n 780-C0224)
  (Power, A/V, Data, Control interfaces)

NOTE: Based on customer application GMS may deliver additional cables and antennas. Contact GMS for further information.

The MDT-B is pre-configured by GMS prior to shipment (based on customer requirements), thus is ready to work "right out of the box".

5.1 Initial Checkout

Prior to installing a MDT-B unit into the desired target environment, an initial checkout should be performed to ensure proper operation of the unit. The initial checkout consists of configuring a basic MDL-B link.

Figure 1 shows a basic configuration to establish a MDL-B wireless link (NOTE: MDR-B and D/C units and their associated hardware are sold separately). The steps necessary to setup the configuration shown in Figure 1 are shown below:

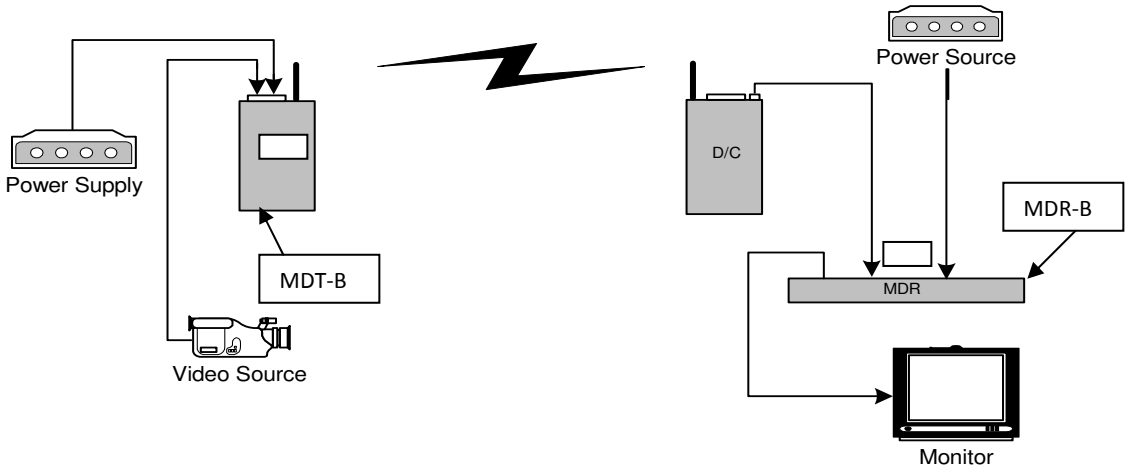


Figure 1 - Basic MDL Link Setup

1. Install omni-directional antennas onto the MDT-B RF output port and Down- Converter (D/C) RF input port. ***Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working.***
2. Attach the MDT-B breakout cable (DB-44 end) to the MDT-B unit.
3. Attach a RF cable from the D/C IF output port to MDR-B IF IN #1 port.
4. Attach a composite video source to MDT-B BNC video input cable (marked CVBS/Y) that is located on the MDT-B breakout cable. S-video and Component video input is also available.
5. Attach a video cable from one of the BNC video output ports on the MDR-B to a video monitor.
6. To prepare to power the MDT-B unit, attach the red and black wires from the MDT-B breakout cable to +12 V terminal and ground of power supply, respectively. NOTE: The power supply used needs to be able to provide at least 1.2 Amp of current at a nominal +12 VDC input. To prepare to power the MDR-B, attach +12 VDC to provided power pigtail.
7. Turn on the video source and video monitor equipment.

8. Apply power to the MDT-B and the MDR-B unit by attaching +12volts. To turn on the D/C, either 1) from the front control panel of the MDR-B toggle through the menus until "R1 (or R2 in the case of diversity systems) BDC POWER DISPLAY" is displayed. Ensure power is toggle "ON" (default mode is "ON" when shipped with down converters (D/C). [NOTE: This places +12VDC (sourced by the MDR-B) onto the IF IN #1 port which, via the attached coax cable, provides power up to the D/C] or 2) if using local +12 Vdc to power up the D/C then ensure the MDR-B "R1 BDC POWER DISPLAY" is set to "OFF" and apply +12 Vdc to pin 1, GND to pin 3 of the DB-9 pin connector located on the bottom side of the D/C. The power switch on the side of the D/C will control the 'ON'/'OFF' positions for local power. See Section 8 at the end of this document for further explanation of local and remote powering of the D/C and when to use each one.

9. After approximately 45 seconds, the link should be established and video provided by the source should be displayed on the monitor.

The initial checkout described above is simply to check the basic video operation of the MDT-B unit. For further details on monitoring and controlling the MDT-B using GMS' optional MS Windows-based MDLB Configurator software program, see Section 6.0.

6.0 Hardware Overview

There are two basic transmitter configurations: the standard MDT-B and the inline professional camera unit (this is an optional enclosure for mounting the standard MDT- B in professional camera applications). The hardware for each configuration is shown below:

6.1 Standard MDT-B

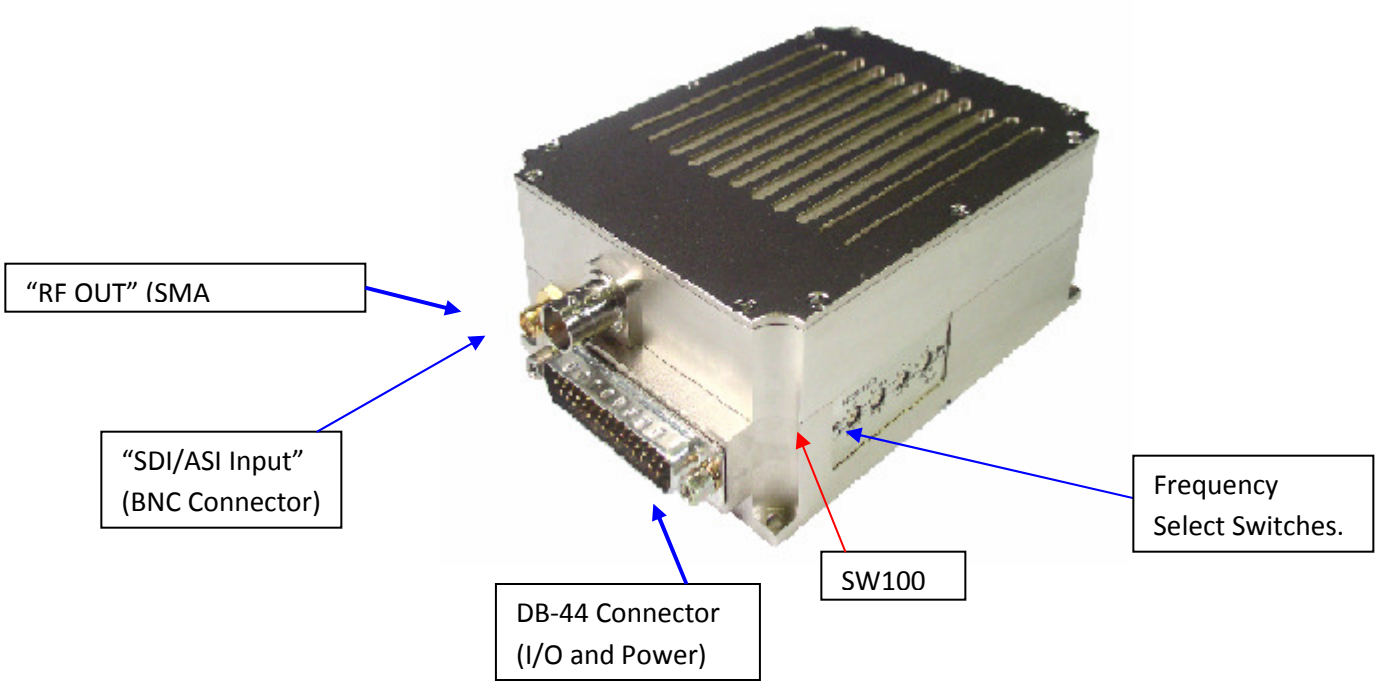


Figure 2 - MDT-B Connectors

6.1.1 MDT-B Connectors

There are three connectors located on the MDT-B unit as shown in Figure 2. They are for interfacing the RF, SDI/ASI, audio, video, power, RS-232 signals.

6.1.1.1 RF Output

The MDT-B uses a female SMA bulkhead connector for its 'RF Output' port.
Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working.

6.1.1.2 I/O

The 'I/O' connector is a male, high-density DB-44. It is used to provide the interface for external power, audio, analog video and RS-232 signals. The MDT-B has a separate RS232 channel (labeled "Control" on the external breakout cable) for control and monitoring the unit. GMS MDLB Configurator software program (as explained in section 6) makes use of the RS232 control lines. The RS-232 channel utilizes a 3-wire configuration. The pin out for the I/O connector is shown in Table 1. NOTE: A USB connector and an additional RS232 channel (labeled "DATA") are currently provided with the external breakout cable . The USB interface is an alternate method of interfacing to the PC if DB-9 connectors are not available. The "Data" RS232 channel is dedicated for low-rate data to be transmitted along with the audio and video.

6.1.1.3 SDI/ASI Input (optional)

A BNC connector is provided for Serial Digital or Asynchronous Digital data streams.

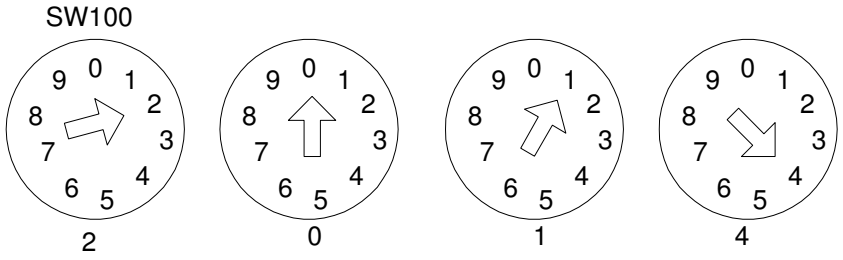
Table 2 - I/O DB-44 Connector Pin Out

Pin	Signal	Notes
1	RS232 Data Tx	
2	RS232 Data Rx	
3	RS232 GND	
4	Not connected	
5	SDA	I^2 C bus
6	SCL	I^2 C bus
7	CVBS/Y	Dual use input. 1. **Composite video in**; 2. **Luminance in** (when used with S or Component Video). Must be selected with GMS Control Software or through the front panel of the in-line camera mount box
8	GND	GND for composite video
9	C/Pr	Dual use input. 1.**Chroma video** (when used with S-video); 2. **Pr** (red component when used with Component Video). Must be selected with GMS Control Software or through the front panel of the in-line camera mount box.
10	GND	GND for chroma video/Pr component
11	Pb	Blue component when used with Component Video.
12	GND	GND for Pb component
13	GND	GND
14	11-15Vdc	Input power to unit

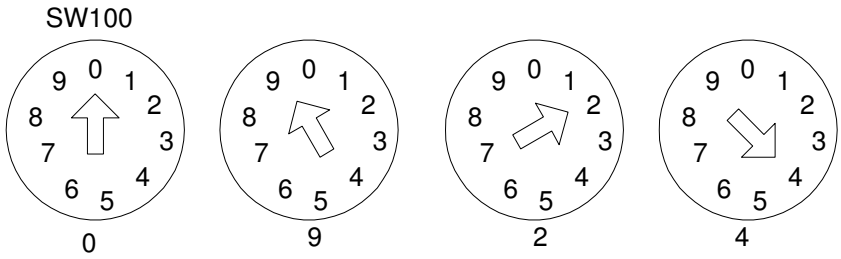
15	Not connected	
16	USB power, Reset	
17	USB Data -	
18	USB Data +	
19	USB Gnd	
20-29	Not connected	
30	PA_Shut_DN	Provides TTL level [+3V] signal for control of external PA
31	RS232 Control Tx	
32	RS232 Control-Rx	
33	RS232 GND	
34-36	Not connected	
37	Audio right +	
38	Audio right -	
39	Audio right line opt.	Pin 39 is connected to pin 38 for audio right channel input impedance of 600 ohms , balance in (mic or line level)
40	Audio right GND	
41	Audio left +	
42	Audio left -	
43	Audio left line opt	Pin 43 is connected to pin 42 for audio left channel input impedance of 600 ohms; balance in (mic or line level).
44	Audio left GND	

6.1.2 Frequency Select Switches

There are four external rotary switches mounted into the chassis of the MDT-B (see Figure 2). They are used to control RF frequency selection. Frequency selection can also be controlled through GMS control software; see section 6. The rotary switches can be disable or enable using GMS control software; refer to section 6.3.3.2 under Configuration/Special Setup/Others. The most significant switch (SW100) represents 1000MHz (0-9) units, the second switch (SW101) represents 100 MHz (0-9) units, the third switch (SW102) represents 10 MHz (0-9) units and the fourth switch (SW103) represents 1 MHz (0-9) units. Hence the highest switch selection can be 9999 MHz and the lowest is 0000 MHz. For example with the switches in the following positions, the frequency will read 2014 MHz:



And with the switches in the following positions the frequency will read 924MHz:



Note the following: if the switches are selected for a frequency outside the range of the frequency band of the MDT-B: the transmitter will default to the high side of the frequency band if the switches are set for a frequency higher than the transmitter frequency band. It will default to the low side of the frequency band if the switches are set for a frequency lower than the transmitter frequency band.

6.2 MDT-B Inline Camera Unit (optional)

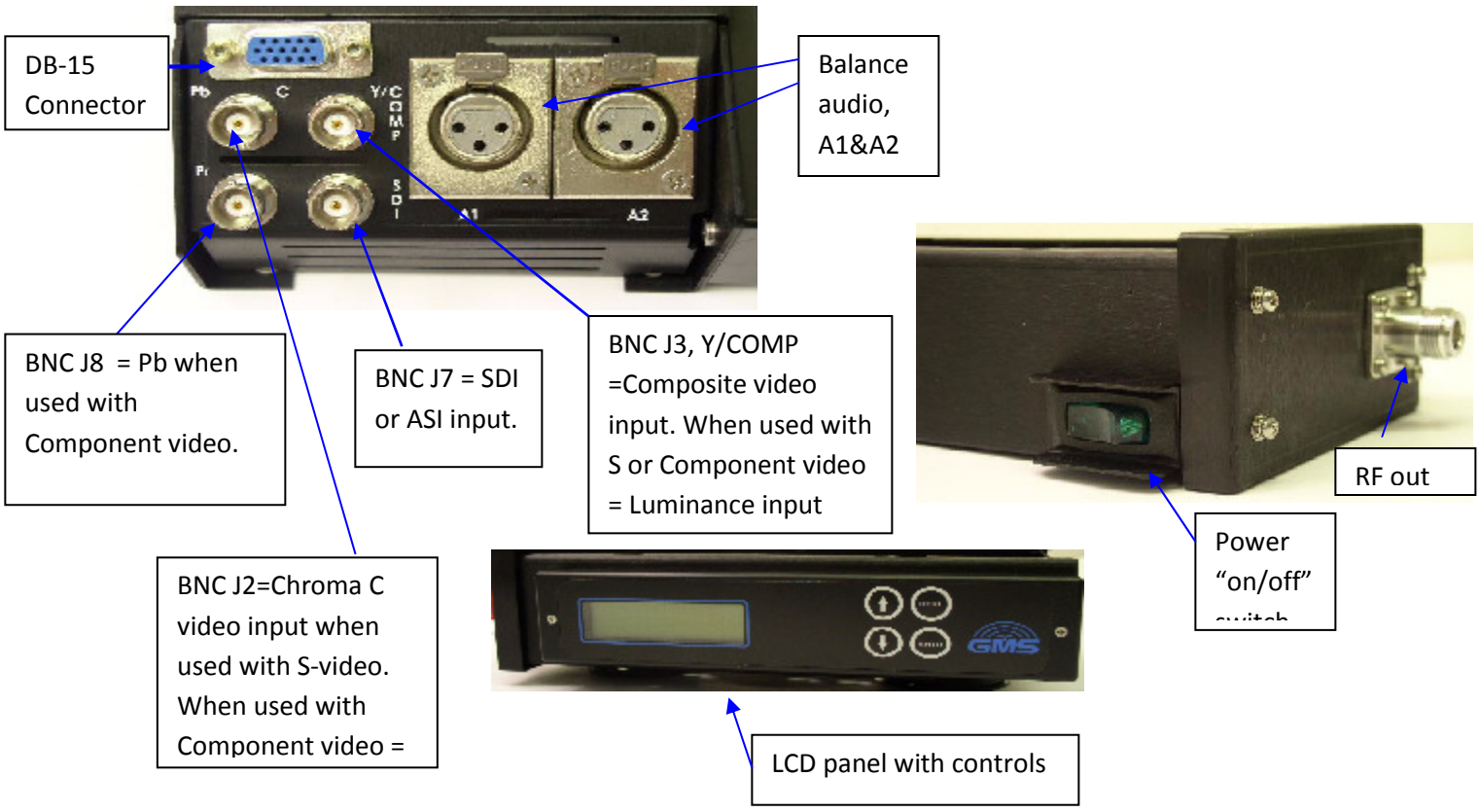


Figure 3 - MDT-B Inline Camera Unit

6.2.1 MDT Inline Camera Mount Connectors

There are four BNC connectors, two audio XLR, one DB-15 connector, one N type connector and one rocker on/off power switch located on the MDT inline camera unit for interfacing the

RF, audio, video, power and RS-232 signals. An optional LCD control front panel is also available. Inline camera mount is shown in Figure 3.

6.2.1.1 RF Output

The MDT in line camera enclosure uses a female N type connector (flange mount) for its 'RF Output' port.

Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working.

6.2.1.2 I/O

The 'I/O' connector is a female, DB-15. It is used to provide the interface for RS-232 signals (control and monitoring). GMS MDLB Configurator software program (as explained in section 6) makes use of the RS232 control lines, pins 2, 3 and 5 of the DB-15 connector. The RS-232 channel utilizes a 3-wire configuration. The pin out for I/O connector is shown in Table 2.

A USB connector is currently provided with the external serial cable for future update capabilities which are currently under development. The USB will be an alternate method of interfacing to the PC if DB-9 connectors are not available.

Table 3 - I/O DB-15 Connector Pin Out

Pin	Signal	Notes
1	+12Vdc	
2	RS232-Rx (CTRL)	Relative to MDT (i.e., control data is input on this pin)
3	RS232-Tx (CTRL)	Relative to MDT (i.e., control data is output on this pin)
4	Not connected	
5	RS232-GND	Common ground for both RS232 Data and Control lines
6	I^2C_D	
7	I^2C_C	
8	USB Reset	*+5V*
9	USB Data -	
10	USB Data+	
11	USB GND	
12	Not connected	
13	RS232-Tx (DATA)	
14	RS232-Rx (DATA)	
15	RS232-GND	

6.2.1.3 Video Input

The MDT –B in-line camera enclosure uses female BNC connectors for video input. Component, Composite or S-Video input is accepted (see section 6 for setting video input type). J3 BNC connector marked "Y/COMP" is a dual use input connector; a) Composite Video or b) Luminance when used with Component video. J2 BNC connector marked "C/Pr" is a dual use input connector; a) Chroma when used with S-Video or b) Pr, the red component minus the luminance information used with Component Video. J8

BNC connector marked "Pb" is the blue component minus the luminance information used with Component Video.

6.2.1.4 Power Switch

An LED indicator rocker switch is provided for controlling power to the unit.

6.2.1.5 LCD Display

An optional LCD display with a front control panel is available for the inline camera mount unit. Many of the control functions which are normally handled through the software interface and a PC can now be accessed directly with the front control panel and displayed on the LCD such as changing frequencies, checking video lock status among many others.

6.2.1.6 SDI/ASI Input (optional)

A BNC connector is provided for Serial Digital Interface or Asynchronous Digital Interface input data streams.

7.0 Software Overview

Configuration, control and monitoring of the MDT-B unit are done by using GMS' optional (sold separately) MS Windows-based MDL_B Configurator software program. This Graphical User Interface (GUI) program provides the end user with a straightforward way to interface with the MDT-B unit. During normal operation, once a MDL-B link is established, the MDL_B Configurator GUI does not need to be active and can be disconnected from the MDT-B unit.

7.1 System Requirements

The MDL_B Configurator program has been developed and tested on Windows 2000, Windows XP and Windows NT. Although the MDL_B Configurator program may work properly on other operating systems, only the Windows 2000, Windows XP and Windows NT environments have been used at GMS and no support or assistance can be provided concerning other operating systems.

7.2 Installation

The following instructions outline the installation process for the MDL_B Configurator program:

1. Insert provided CD-ROM into computer.
2. Click on 'setup.exe' file. This will launch the GMS_MDL Setup program and several initial setup files will begin to be copied onto the computer.
3. After the initial setup files are copied over, the GMS_MDL Setup program will prompt the user to close any applications that are running. Once all other programs are exited, click on the 'OK' button.
4. The GMS_MDL Setup program will prompt the user to click on the 'computer icon' button to begin installation. If desired, the user can change the destination directory from the default. Click on the 'computer icon' button.
5. The GMS_MDL Setup program will then prompt the user to 'Choose Program Group'. If desired, the user can change the program group from the default. Click on the 'Continue' button.
6. After quickly installing the MDL Configurator program, the GMS_MDL Setup program will put up a window indicating that setup was completed successfully. Click 'OK'.

7.3 MDL_B Configurator Functions

The MDL_B Configurator program provides the user access to many different configuration, control and monitoring options. When the MDL_B Configurator program is launched, the screen shown in Figure 4 is displayed. The user should first select the serial port their computer is connected to via the Serial Port Selector and Status region. If the selected serial port is valid, the gray-colored status box will show 'Ready'. The Device Selector region allows the end user to choose to interface to a MDT-B or MDR-B unit. To configure a MDT-B, select the 'MDT-B' box in the Device Selector region. Once the 'MDT-B' box is selected, the screen shown in Figure 5 is displayed. The MDT-B Configurator program contains function buttons and all the configurable settings available on a MDT-B. The following sections explain, in detail, the various options.

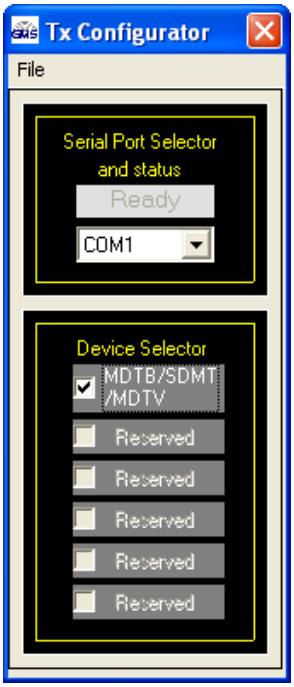


Figure 4 - MDL_B Configurator Main Screen

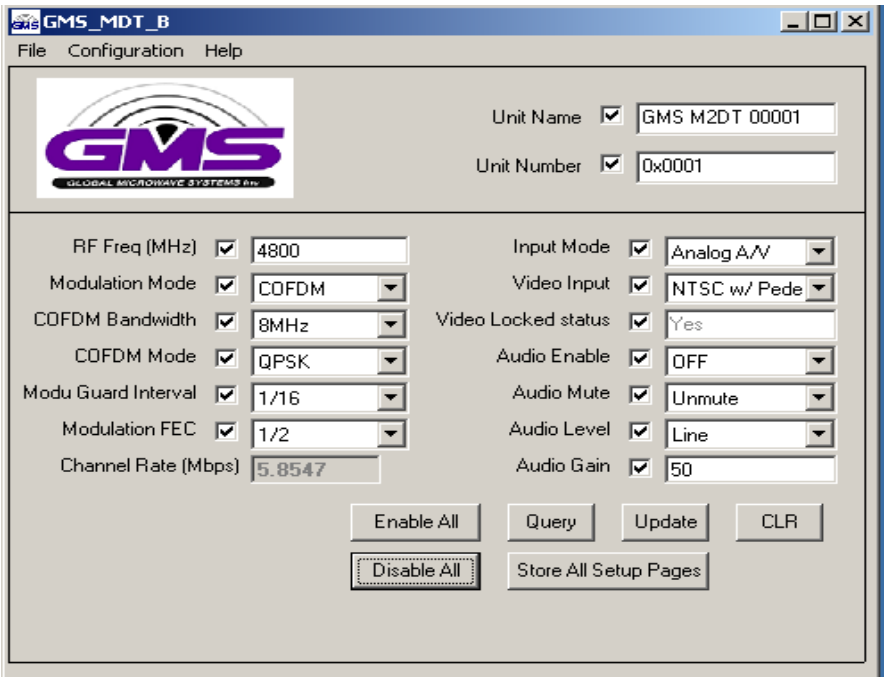


Figure 5 - MDT Configurator Main Screen

7.3.1 Function Buttons

- "**Enable All" Button**: Clicking on this button enables all the check boxes on the screen. This operation is done to prepare all the fields to be written to (or read from). Alternatively, the end user can individually select a given field by using the mouse and clicking its corresponding check box.

- "**Disable All" Button**: Clicking on this button disables all the check boxes on the screen. This operation is done to inhibit all the fields to be written to (or read from). Alternatively, the end user can individually deselect a given field by using the mouse and clicking its corresponding check box.

- "**Query" Button**: Clicking on this button performs a read operation on all the fields that have their check box enabled. Once clicked, all the selected fields will be read back reflecting their current configuration.

- "**Update" Button**: Clicking on this button performs a write operation on all the fields that have their check box enabled. Once clicked, all the selected fields will be written to with the value denoted in their respective field.

- "**CLR" Button**: Clicking on this button clears out all fields on the screen, regardless of whether the fields' check boxes are selected or not. This button proves useful when the end user wants to verify that a write operation has been correctly performed. An example scenario would be to 1) enable all fields, 2) change desired field(s), 3) perform a 'Update' (write) operation, 4) perform a 'CLR' operation and 5) perform a 'Query' operation. As a result of the 'Query' operation, the fields on the screen should all update to those values that were written during the 'Update' operation.

- "**Store All Setup Pages**" **Button**: Clicking on this button will store all setup pages, even if they are not shown.

7.3.2 Field Definitions

There are several different fields that can be configured by the MDT-B Configurator. The fields located in the main screen of Figure 5 and their associated values are defined in Table 3 below. Also noted in the table is whether the field is read, write-able or both

Table 4 - MDT Field Definitions

Field	R/W	Description
Unit Name	R/W	Allows the user to assign a unique unit name to the MDT.
Unit Number	R/W	Allows the user to assign a unique unit number to the MDT
RF Freq (MHz)	R/W	RF output frequency. Desired frequency is entered in MHz (i.e., 1.296GHz would be entered as 1296).
Modulation Mode	R/W	Modulation mode. Desired modulation mode is selected from the following values*: COFDM (default) Off (shuts off modulation)* or *I/Q CAL ON (puts unit in calibration mode).*
C-OFDM Bandwidth	R/W	**COFDM** transmit bandwidth. Desired bandwidth is selected from the following values: *6, 7 or 8 MHz*.
C-OFDM Mode	R/W	**COFDM** modulation type. Desired **COFDM** modulation type is selected from the following values: *QPSK, 16 QAM* or 64 QAM
Mod Guard Interval	R/W	Modulation guard interval size. Desired modulation guard interval size is selected from the following values: *1/32, 1/16, 1/8 or ¼*.
Modulation FEC	R/W	Modulation FEC (Forward Error Correction) rate. Desired modulation FEC rate is selected from the following values: *½, 2/3, ¾, 5/6, 7/8*.
Channel Rate (Mbps)	R	Channel rate is displayed based on parameters selected such as COFDM mode, FEC and Guard Interval.
Input Mode	R/W	Choice between Analog video, SDI (serial digital interface) or ASI (asynchronous digital interface)
Video Input	R/W	Video input format. Desired video input format is selected from the following values: *PAL, NTSC w/ Pedestal, NTSC, S-video PAL, S-video NTSC, and Component Video. Some of these choices may or may not be shown in the pull down box depending on which user profile has been loaded.*
Video Locked Status	R	Analog video lock status. This read-only field indicates that the MDT-B has line-locked onto the analog video input signal [*not applicable when the "Input Mode" is set to either SDI or ASI]*

Field	R/W	Description
Audio Enable *	R/W	Analog audio encoder enable. Desired mode of operation of the audio encoder is selected from the following values: *Off or On.*
Audio Mute *	R/W	Choice between *mute* or *un-mute* audio stream
Audio Level *	R/W	Choice between *mic* or line *level* audio
Audio Gain *	R/W	Adjustable gain between 0- 100

- *Not applicable for embedded audio applications.*

7.3.3 Pull-Down Menu Definitions

There are several different pull-down menus that are included in the MDT-B Configurator program. Each of these pull-down menus contains further user-configurable options or commands. The following sections describe these menus in detail.

7.3.3.1 File

This pull-down menu offers to exit the MDT-B Configurator program or to "Save Parameters". Alternatively the 'X' box in the upper right hand corner of the window can be used to exit the program. And alternatively the "Store All Setup Pages" button on the main menu will save all parameters.

7.3.3.2 Configuration

This pull-down menu contains several different configuration options. These are outlined below:

- ***Special Setup***
  - ***Load MPEG Encoder Profile*** *(see figure 6)* – This menu displays the current profile loaded and also presents possible profiles to load. Select the profile from the pull down box (or use the browse button to point to area where other profiles are located). Then click on the "Download Profile" button. A progress bar appears which shows the profile loading. After the profile has been downloaded it's necessary to click on the "Store all Setup" button for the profile to be saved. Once the profile is stored a message box appears indicating the profile is stored. If the message box states the process failed then click on the "Store All Setup" button again. Repeat until the message box indicates the profile is stored.
  - ***Others*** (see figure 7)- This menu displays the following:
    - ***RF Output attenuation –*** The RF out can be attenuated in 0.5 or 1 dB increments up to defined max. Both increment step and max value are frequency band dependant.
    - ***COFDM Spectrum Inversion*** choices include normal or invert. The transmitter is configured with the receiver it ships with and the inversion mode shouldn't have to be changed. However if a different receiver is used the inversion mode may have to be changed. Some receivers will accept either inversion mode. Check the parameters of the receivers to ensure the correct inversion mode is selected.
    - ***RF Power Mode***–Can be used to put transmitter in a sleep mode, a low power mode where the encoder functions and many of the power regulators are shut down enabling a saving in current when transmitter is not active. The ***OFF*** state of the unit is displayed on the main window

(see figure 7a). To have the unit in the desired ***RF Power Mode*** on Power up, it is necessary to store settings in the ***Others*** window. If the settings are stored in the main page, the state of the ***RF Power Mode*** will not be saved.

- ***Frequency switch*** – choices offered are enabled or disabled. These are the four frequency select switches discussed under section 5.1.1.3. If disabled the switches will not respond to changes (frequency changes could still be accomplish by changing the "RF FREQ (MHz") field in the GMS MDLB control software. Enabling them allows the frequency to be changed when the switches are changed. Factory default enables the switches (keep in mind that you must click on the "Store All Setup Pages) for the choice to take place.
- ***Video Filter Type***–Pull down box offers various filter types for optimizing picture. The choices include: LPF OFF, LPF C, LPF Y, LPF YC.
- ***Video Filter Frequency***– Pull down box offers various filter frequencies for optimizing picture. The choices include: AUTO, 12.15MHz, 10.6MHz, 9.45 MHz, 8.1 MHz and 6.75 MHz.

- ***Transport Stream*** *(see figure 8)* – The transport stream menu displays the parameters of the current transport stream (of the transmitter). The fields are read/write-able. Normally the fields require no manipulation and should work quite well as defaulted from the factory. However, high end users may have a need to change the transport stream parameters.
- ***Ctrl Port Baud Rate***- The control port baud rate menu allows different baud rates to be selected when attached to the PC RS232 port. Some computers may need the baud rate adjusted for optimal communications
- ***Factory Setup*** – The menu is for factory use only.

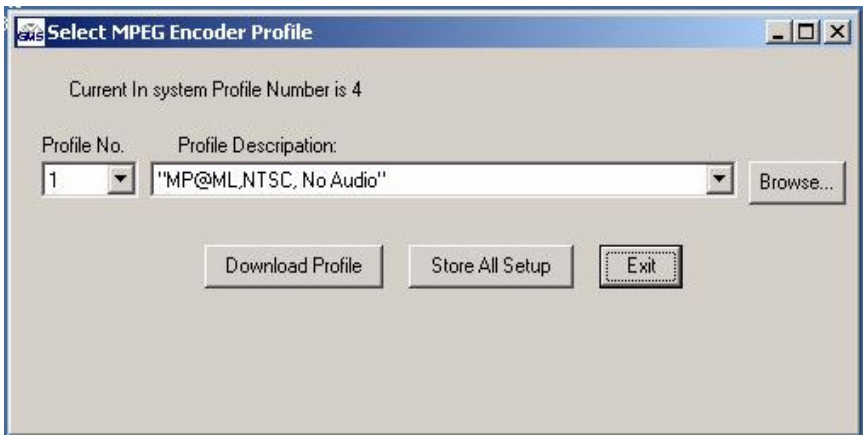


Figure 6 - Select MPEG Encoder Profile

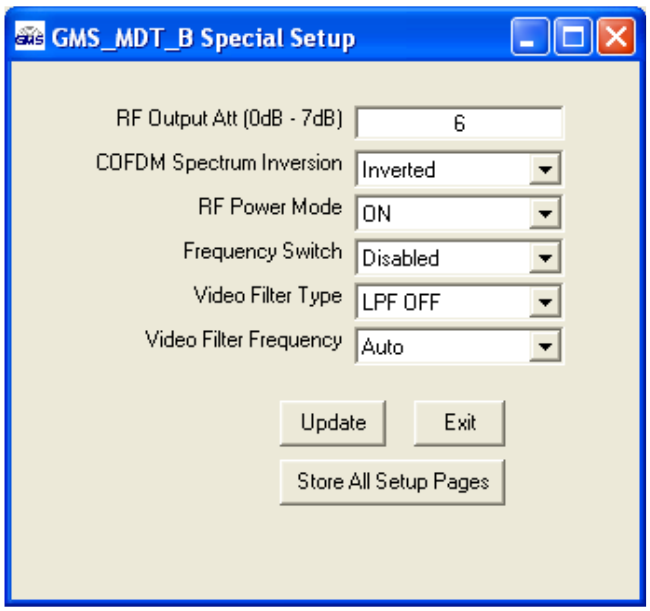


Figure 7 - Others

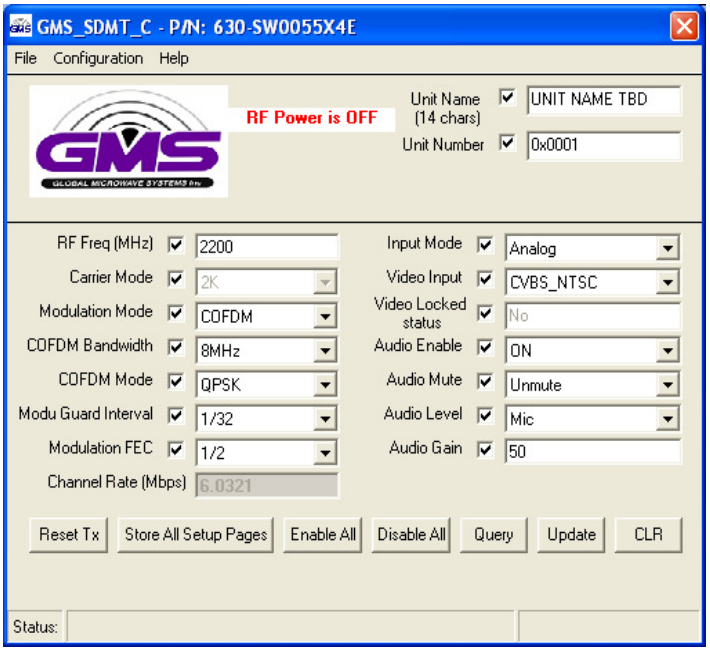


Figure 7a – RF Power Off

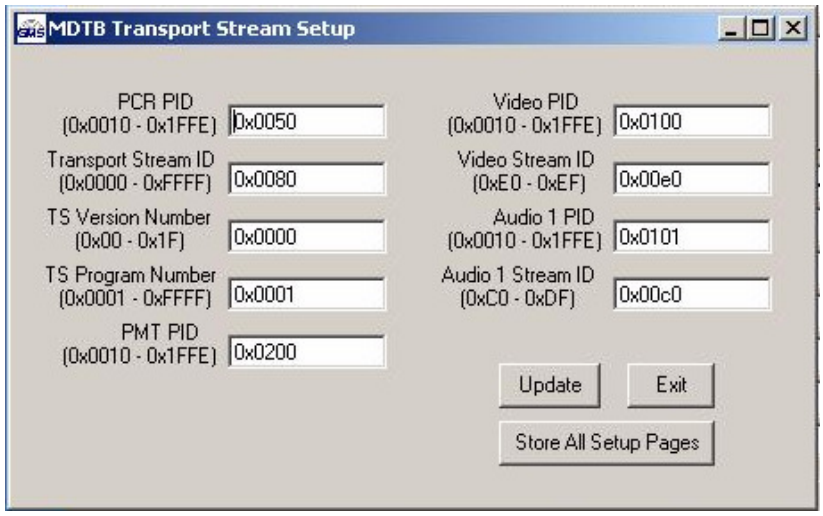
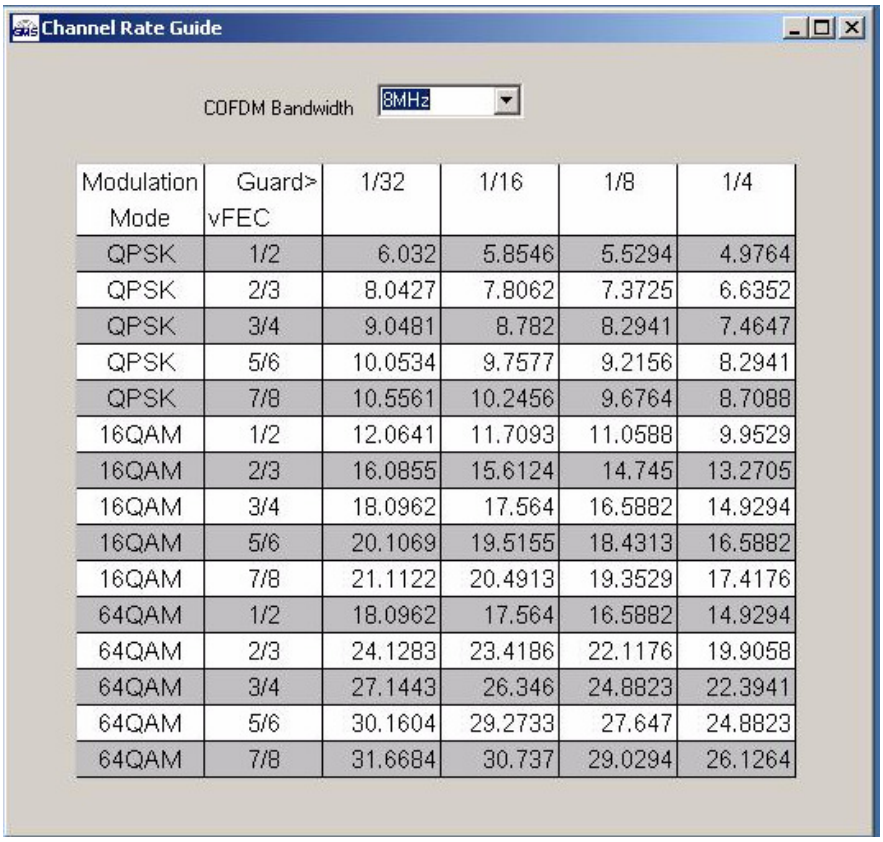


Figure 8 - Transport Stream Setup

7.3.3.3 Help

This pull-down menu contains information about the MDT firmware and the MDL Configurator software. This information is outlined below:

- *Channel Rate Guide*: This selection pulls up a table which displays the relationship between the Modulation mode, Modulation Guard Interval and FEC mode. Table values will change depending on COFDM Bandwidth selected. See figure 9.
- *FW version*: This selection pulls up a window that displays the MDT-B current Profile Index (current loaded profile), the Profile Description, the Software Version, the FPGA Version and Serial Number. See Figure 10.
- *About*: This selection pulls up a window that displays the Version Number of the GMS MDL_B Configurator program.



Modulation Mode	Guard> vFEC	1/32	1/16	1/8	1/4
QPSK	1/2	6.032	5.8546	5.5294	4.9764
QPSK	2/3	8.0427	7.8062	7.3725	6.6352
QPSK	3/4	9.0481	8.782	8.2941	7.4647
QPSK	5/6	10.0534	9.7577	9.2156	8.2941
QPSK	7/8	10.5561	10.2456	9.6764	8.7088
16QAM	1/2	12.0641	11.7093	11.0588	9.9529
16QAM	2/3	16.0855	15.6124	14.745	13.2705
16QAM	3/4	18.0962	17.564	16.5882	14.9294
16QAM	5/6	20.1069	19.5155	18.4313	16.5882
16QAM	7/8	21.1122	20.4913	19.3529	17.4176
64QAM	1/2	18.0962	17.564	16.5882	14.9294
64QAM	2/3	24.1283	23.4186	22.1176	19.9058
64QAM	3/4	27.1443	26.346	24.8823	22.3941
64QAM	5/6	30.1604	29.2733	27.647	24.8823
64QAM	7/8	31.6684	30.737	29.0294	26.1264

Figure 9 - Channel Rate Guide

Figure 10 - FW Version

8.0 Specifications

The following sections outline the overall specifications for the MDT unit.

8.1 Video Encoding

Interfaces: SDI, Component, Composite or S-Video Input
Standards: NTSC or PAL
Compression Standard: MPEG-2 (per ISO/IEC 13818-2)
Profiles: 422P@ML, MP@ML, SP@ML
Video Bit Rate: 2Mbps to 15Mbps (MP@ML)
3Mbps to 25Mbps (422P@ML)
Chrominance Profile: 4:2:2 or 4:2:0
Line Standard: NTSC: 525 or 480
PAL: 625 or 576
Horizontal Resolution: 720 pixels
Vertical Resolution: 480 (525 line) and 576 (625 line)
System Latency end to end delay: <80ms (super low latency mode)

8.2 Audio Encoding

Analog Audio: Dual, Line-Level or Mic-Level, Differential or Single-Ended, Clip Level 12dBm
Impedance: 600 Ohms input impedance (changeable to 2K Ohms)
Compression Standard: MPEG layer II
Audio Enable: On or Off
Bit Rates: Up to 384kbit/s/ch
Sampling Frequency: 32 kHz, 44.1 kHz or 48 kHz
THD: < 0.1% maximum
Response: 20 Hz to 12 kHz, +/- 0.25 dB
Crosstalk: >55dB minimum
S/N: >60 dB RMS

8.3 Transport Stream

Standard: per ISO/IEC 13818-1
Packet Size: 188 byte
Bit Rate: Automatically set from active service settings.
ASI Input: Allows MPEG2 transport stream to be inserted into the MDT-B through the BNC connector

8.4 RS-232 Interfaces/RCU

Control Port: 3-wire interface (Tx,Rx,Gnd)
RCU A remote portable control unit is also available
Note: A USB interface is also available that serves the same purpose as the RS232 control port. In addition a "Data" RS232 channel is available which is dedicated for low-rate data to be transmitted along with the audio and video.

8.5 COFDM RF Output

Output Frequency: 1 to 6 GHz (In-Bands)
Frequency step size is 500 KHz for all bands except S2 (1999-2500 MHz) which is 250 KHz.
Bandwidth: Selectable 6, 7 or 8 MHz

Output Power: Up to100mW (programmable) [200mW on some models]
Connector: **SMA-F**
Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working. A proper heat sink is also required.

8.6 **Modulation**

Modulation Type: COFDM w/ QPSK, 16 QAM or 64 QAM
FEC: ½, 2/3, ¾, 7/8
Guard Intervals: 1/32, 1/16, 1/8, 1/4
Spurious: 50dBc
Number of C-OFDM Carriers: 2k
C-OFDM MER: > -45dB
Standard: DVB-T compliant

8.7 Power

MDT (Frequency 1 to 6GHz In-Bands
DC Input Voltage Range: 9 to 15 VDC
Power Consumption: 10Watts

8.8 Physical Dimensions (without mating connectors)

MDT (Frequency 1 to 6GHz In-Bands
Size: 3.25 in. (W) x 4.5 in. (D) x 1.76 in. (H)
(8.26 cm x 11.43cm x 4.47cm)
Weight: 13.4 oz
(380.5grams)

8.9 Environmental

Operational Temperature: -10 to +70 °C
Humidity: Up to 100% (non-condensing)
.

9.0 The D/C (Down Converter)/IF frequencies explained

9.1 If Frequencies

- MDR-B receivers (and many other digital receivers) are capable of receiving direct frequencies in the range of approximately 49 MHz to 861 MHz. If the transmitter is not in this range then a down-converter is used to convert the frequency to this range. The frequency out of the down-converter is called the IF (intermediate frequency) which is fed to the receiver.

  Down-converters have a LO (local oscillator) which is mixed with the transmitter frequency (MDT-B) and converts it to the IF frequency. MDR-B receivers need to know the LO (local oscillator) of the down-converter and is factory programmed with this information. It then automatically calculates the IF frequency once the RF (transmitter frequency) is entered. Thus as the desired RF frequency is dialed in on the MDR-B the IF is taken care of automatically. For example, if the transmitter frequency (MDT-B) is set for 2000 MHz, then the MDR-B can be set for 2000 MHz (it automatically calculates the IF frequency based on pre-programmed LO information of the down-converter). The IF frequency changes as the RF frequency changes, the LO remains constant.

On non-GMS receivers it may be necessary to program the receiver with the IF frequency directly. The user may have to do the simple math to arrive at the IF frequency so that it can be entered into the receiver. ***The down-converter LO must be known***. The math involve is as follows: " LO – transmitter frequency (or transmitter frequency – LO) = IF frequency". For example, it the transmitter is set for 2000MHz and the LO of the down-converter is 2800MHz then the IF frequency is 800MHz (2800-2000 = 800). The receiver will need to be set to 800MHz to receive the transmitter frequency of 2000MHz. Each time the transmitter frequency is changed the IF must be re-calculated and entered into the receiver. It must also be mentioned, as you may have noticed with the equation "LO-transmitter frequency or transmitter frequency – LO" that two answers are possible. For example 2800-2000 = 800 or 2000-2800 = -800. The negative answer may indicate the receiver wants the signal to be inverted. See section 6.3.3.2 for inverting the signal.

9.2 Local and Remote Power

Customers have the option of using remote or local power:

- Remote power is provided from the receiver through the BNC connector IF IN #1 located on the rear panel (and IF IN #2 in the case of diversity systems with two down converters). IF PWR # 1 (and IF PWR #2 in case of diversity systems) needs to be switched 'ON'. From the front control panel of the receiver (MDR-B) toggle through the menus until "R1 BDC POWER DISPLAY' (or "R2 BDC POWER DISPLAY" in the case of diversity systems) is displayed. Ensure "ON" is selected (this the default mode when shipped with D/C .The +12 Vdc provided from the receiver will travel through the coax cable to the D/C.

  If the D/C is located relatively close to the receiver then using remote power makes sense. However, if the D/C is located at great distances away from the receiver there may be excessive DC voltage drop in the coax cable (due to cable resistances). If this is the case then local DC power should be considered as discussed below. If unsure of the DC voltage drop measure the DC voltage present (using a DMM) at the end of the coax cable run. The D/C normal operating voltage is approximately +12 Vdc but can operate down to +10 Vdc.

- Local power is provided by applying +12 Vdc to pin 1, GND to pin 3 of the DB-9 connector located on the bottom of the D/C. The +12 Volt power supply must be able to source at least 500mA. The power switch (located on the side of the D/C) enables the user to control the 'ON'/'OFF' positions for local power. If using local power then the remote power IF IN #1 should be set to "OFF" (and RF IN #2 in case of diversity systems).

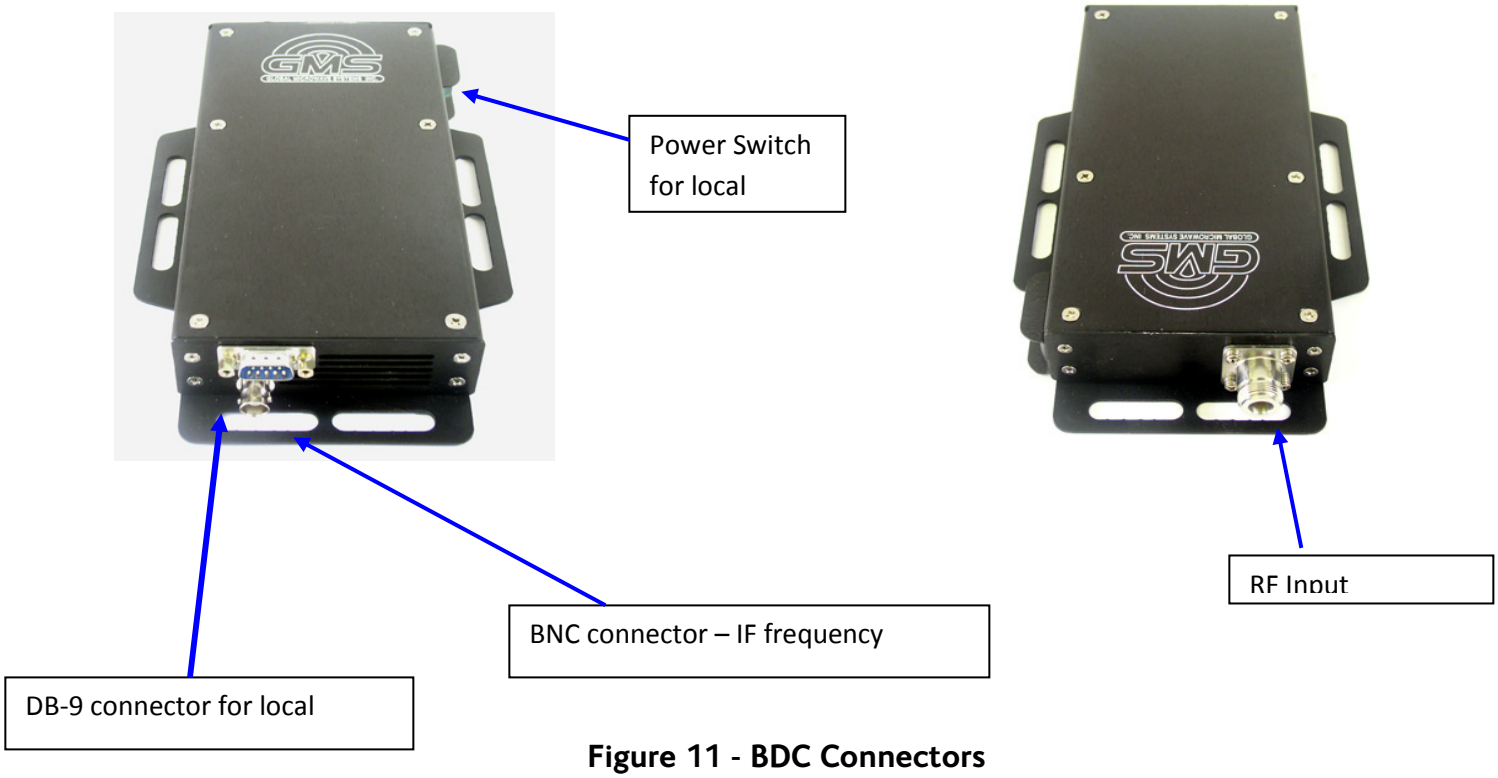


Figure 11 - BDC Connectors

Table 5 - DB-9 Connector Pin Out for the D/C

Pin	Signal	Notes
1	+12Vdc	Power supply must be able to source at least 500mA. Voltage should not drop below +10Vdc.
3	GND	Power ground
2, 4-9	NC	Not Connected

10.0 Cable Losses

10.1 Coax Cable

Cable losses must be taken into consideration if the D/C is located a great distance from the receiver. As mentioned above long cable runs can contribute to more resistance in the lines and also can contribute to signal attenuation because of the additional capacitance. Even when using a good coax cable such as RG59/U the attenuation of the signal can be significant. For example, RG59/U coax will drop approximately 2 dB per 100 feet at 50 MHz and 8 dB per 100 feet at 900 MHz. The intermediate frequency (IF) in this system can fall between 49 MHz to 850 MHz. Cable losses in this range for an RG59/U are shown below in table 5. An inline amplifier matching the cable losses should be considered if losses exceed 6 dB.

Table 6 - RG59/U Coax Cable Losses

Description	Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Nom. Attenuation (dB/100 ft.)
	1			.3
	5			.65
	10			.9
	50			1.9
	100			2.6
	200			3.6
	400			5.0
	700			7.0
	900			8.0
	1000			8.5

- Belden cable # 1426A

NOTES:

1. REFERENCE BOM 780-C0224X2 FOR REFERENCE DESIGNATIONS (SHOWN AS [] ON DRAWING) AND PART DESCRIPTIONS .

2. LABEL FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0224X2 USING BEST COMMERCIAL METHOD.

3. LABEL CONNECTOR WITH REFERENCE DESIGNATOR AND DESCRIPTION AS SHOWN USING BEST COMMERCIAL METHOD. LABEL TO BE WITHIN 3.0 OF CONNECTOR.

4 REFERENCE MANUFACTURING INSTRUCTION 100-MI0112.

5. THIS CABLE IS SET-UP FOR BALANCED AUDIO ONLY.

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0355X1	X1	INITIAL RELEASE	01/19/04 SLP	
E0355X3	X2	**Correct polarity marks of USB, pins17&18**	11/9/05 TG	

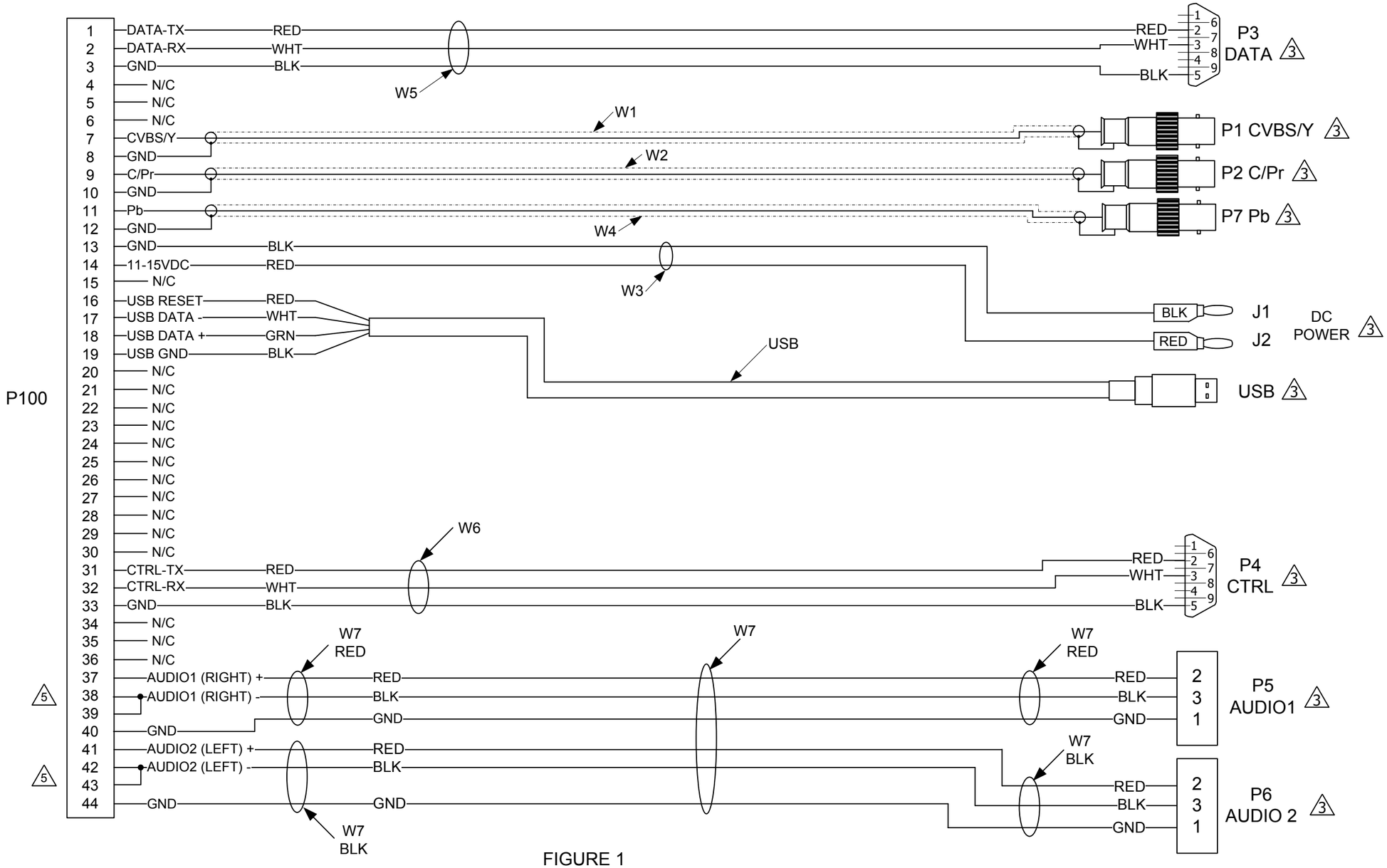


FIGURE 1
CABLE WIRING
DIAGRAM

TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING LINEAR X.X = ± 0.5 X.XX = ± 0.125 X.XXX = ± 0.020	ENG/TECH T. Giotta DRAWN SLP ENG PROD QC	COBHAM GMS Products	DWG TITLE: CABLE, MDT2-B EXTERNAL BREAKOUT FOR BROADCAST VERSION SIZE B · DATE 11/9/05 · DWG NO 100-C0224X2 · REV X2 SCALE: NONE · SHEET 1 OF 5